(6) M - Recall and apply the equation for centripetal force
(7) S - Describe how to find the mass of an object using ideas about centripetal force
(8) C - Determine your own graphical method for finding the mass

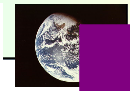
Lesson 3. Exploring centripetal forces

0:00:00

SA

STARTER: The Earth has a radius of 6400 km. If a person has a weight of 700 N, calculate the weight reading on the scale at the Equator.

- 697.6 N
- 724.2 N
- 675.8 N
- 702.5 N



Kilo 10^3 **Support** - Review the equations from last lesson

Mega 10^6

Giga 10^9 **Ex 2** - Radius of moon is 1737km What would be the weight on the equator there?

Key point

- 697.6 N
- 724.2 N
- 675.8 N
- 702.5 N

Correct. 1 day = 86 400 s.
The centripetal force acting on the person is given by

$$\boxed{F = \frac{mv^2}{r}} = \frac{\frac{700}{9.81} \times 465^2}{6400 \times 10^3}$$

$= 2.4$ N

Therefore 2.5 N is subtracted from 700 N to give 697.6 N. For more information see Topic 16.3 *Exploring centripetal forces.*

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0:05:00

ACTIVITY 1: Complete the practical using the sheet.

Kilo 10^3 **Support** - Draw your graph as large as possible to find an accurate gradient.

Mega 10^6 **Ex 1** - Use the sheet with steps removed!

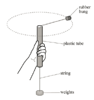
Giga 10^9

Key point

PA

3 Practical

Investigating circular motion



Procedure

1. Tie one end of the thread to a rubber bung and make a mark on the string at a distance of 30 cm from the bung.
2. Attach a 1.0 N weight at the other end of the string and whirl the rubber bung in a horizontal circle as shown in the diagram above. (The centripetal force F on the bung is 1.0 N.)
3. Adjust the speed of the bung such that the radius r of the circle is equal to 30 cm and then continue to whirl the bung at a constant speed.
4. Measure the time t for 10 revolutions of the bung.
5. Determine the speed v of the bung using speed = $\frac{\text{distance}}{\text{time}}$.
   $$v = \frac{10 \times 2\pi r}{t} = \frac{20\pi r}{t}$$
6. Repeat the experiment for different values of centripetal force F and record your results in a table.
7. Plot a graph of force F against v^2. Draw a straight line of best fit.
8. Explain why the gradient of the graph is given by:
   $$\text{gradient} = \frac{m}{r}$$
   where m is the mass of the bung and r is the radius of the circle.
9. Determine the mass of the bung from the gradient. How does it compare with the actual mass of the bung when measured using a digital balance?

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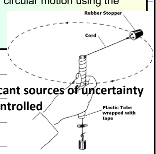
0:00:00

ACTIVITY 1: Without notes - Describe step by step how to **accurately** find the mass of an object in circular motion using the setup below. (focus on the physics)



Kilo 10^3

Mega 10^6 **Extension: Name 2 significant sources of uncertainty and how they could be controlled**

Giga 10^9

Key point

- Add a known **mass/force** to the string
- Rotate the object in a circle of **fixed radius**
- **Measure the time** to make 10 **revolutions.**
- Find the **time period (T)** by **t/10**
- Calculate the average speed of the mass. using $v = 2\pi r/T$.
- Change the centripetal force by adding masses to the string, and repeat.
- Plot a graph of **F against V^2**
- Find the **gradient of line of best fit**
- gradient = r/m (because of F = mv²)
- Rearrange to Find m.

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(6) M - Recall and apply the equation for centripetal force
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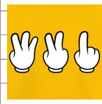
0:05:00

Plenary

What are your top 3 tips for finding the mass of the bung **accurately?**

Consider the procedure / the equipment / the analysis

Ex: You can put them in order of importance!



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